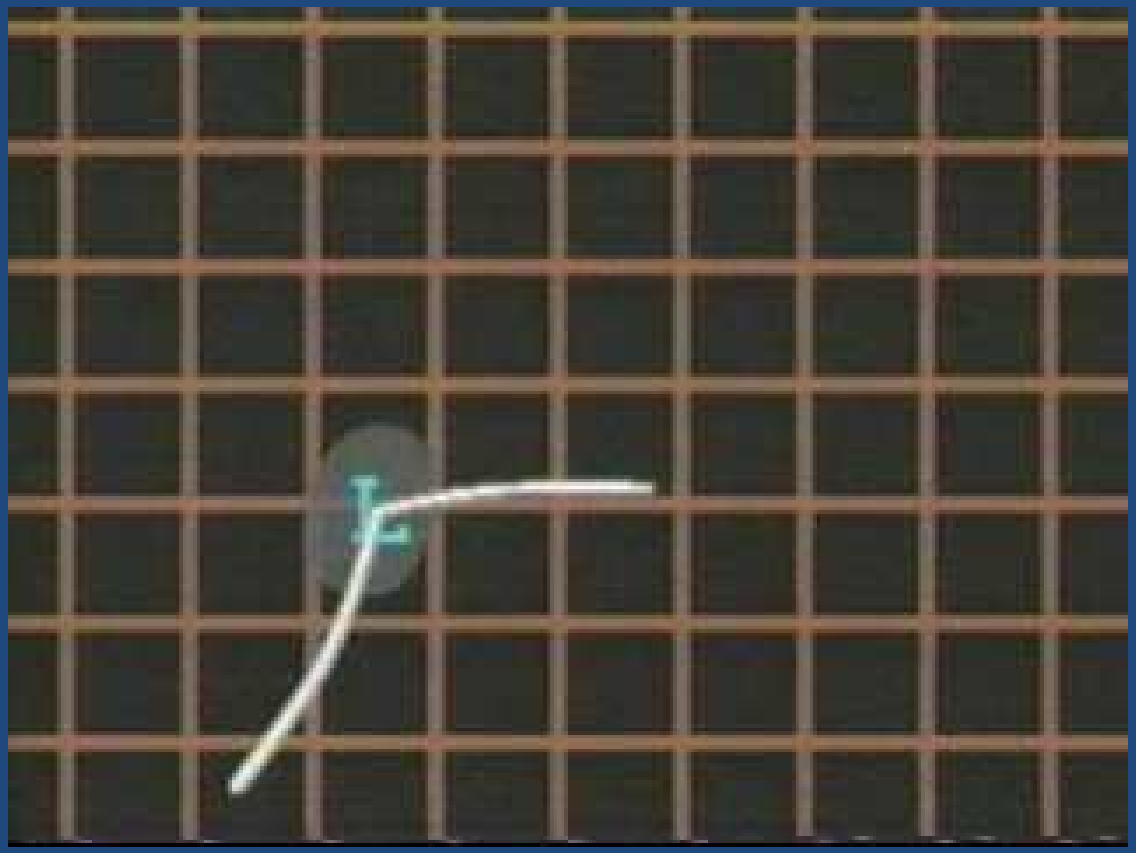
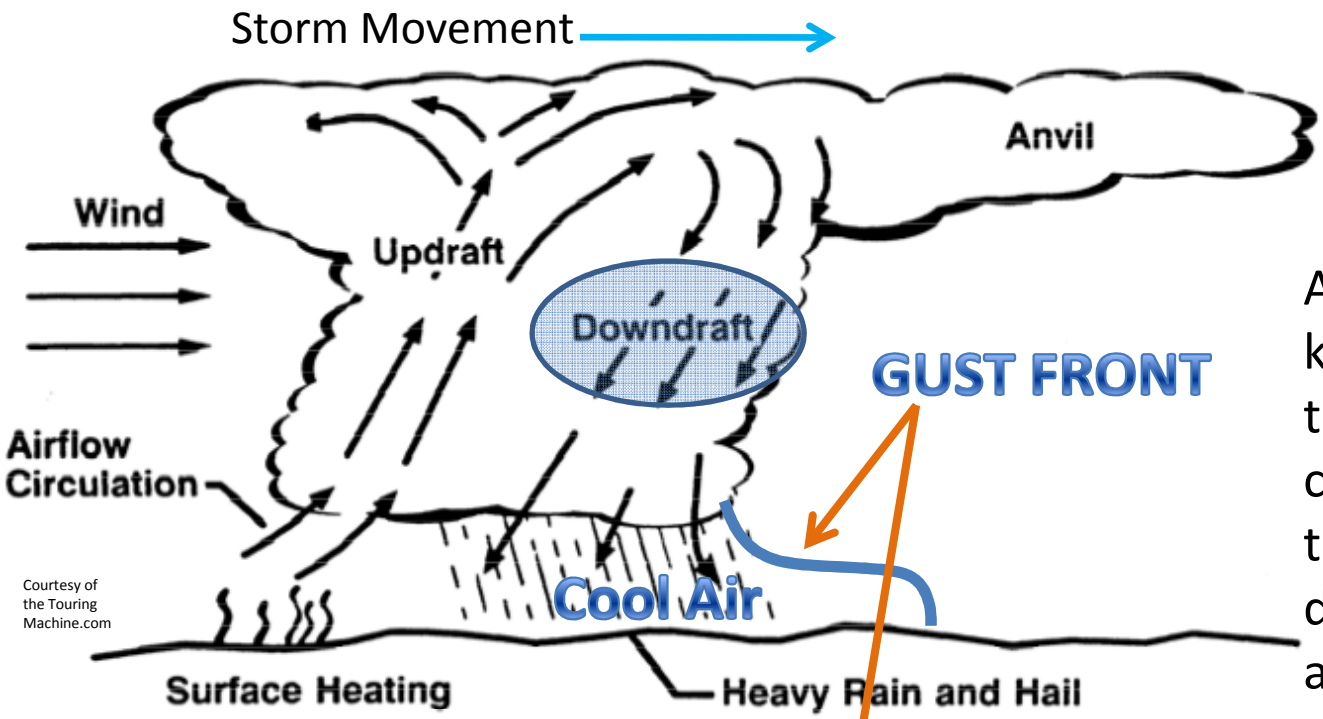
Rear Flank Downdraft (RFD) Impact on Tornadogenesis & Cyclic Supercells



Tornadic Wall Cloud..

Tornadic circulation continues to develop

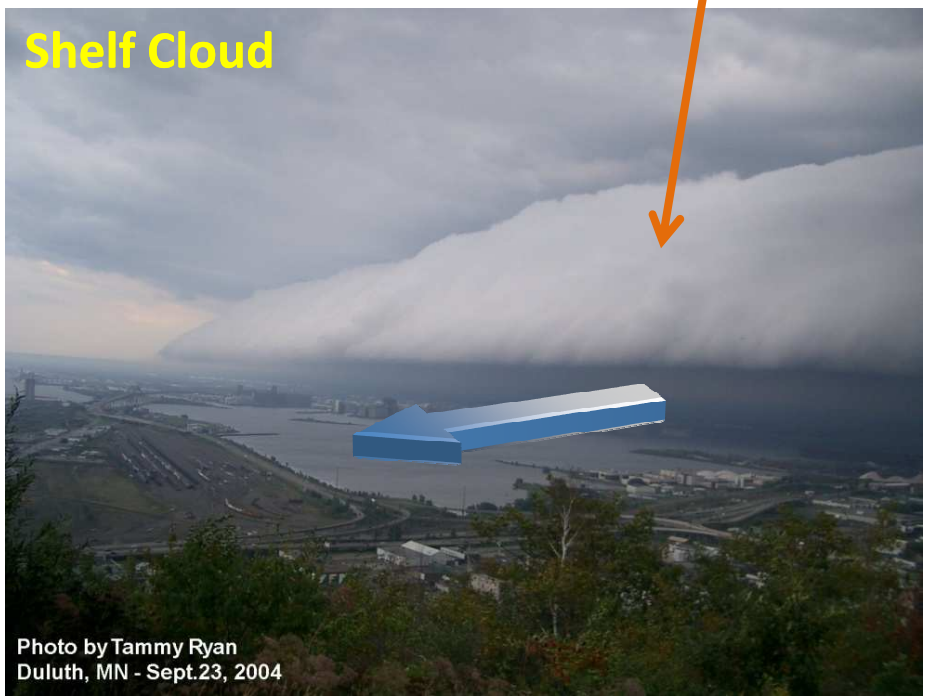
Local Cyclic Supercell



Outflow

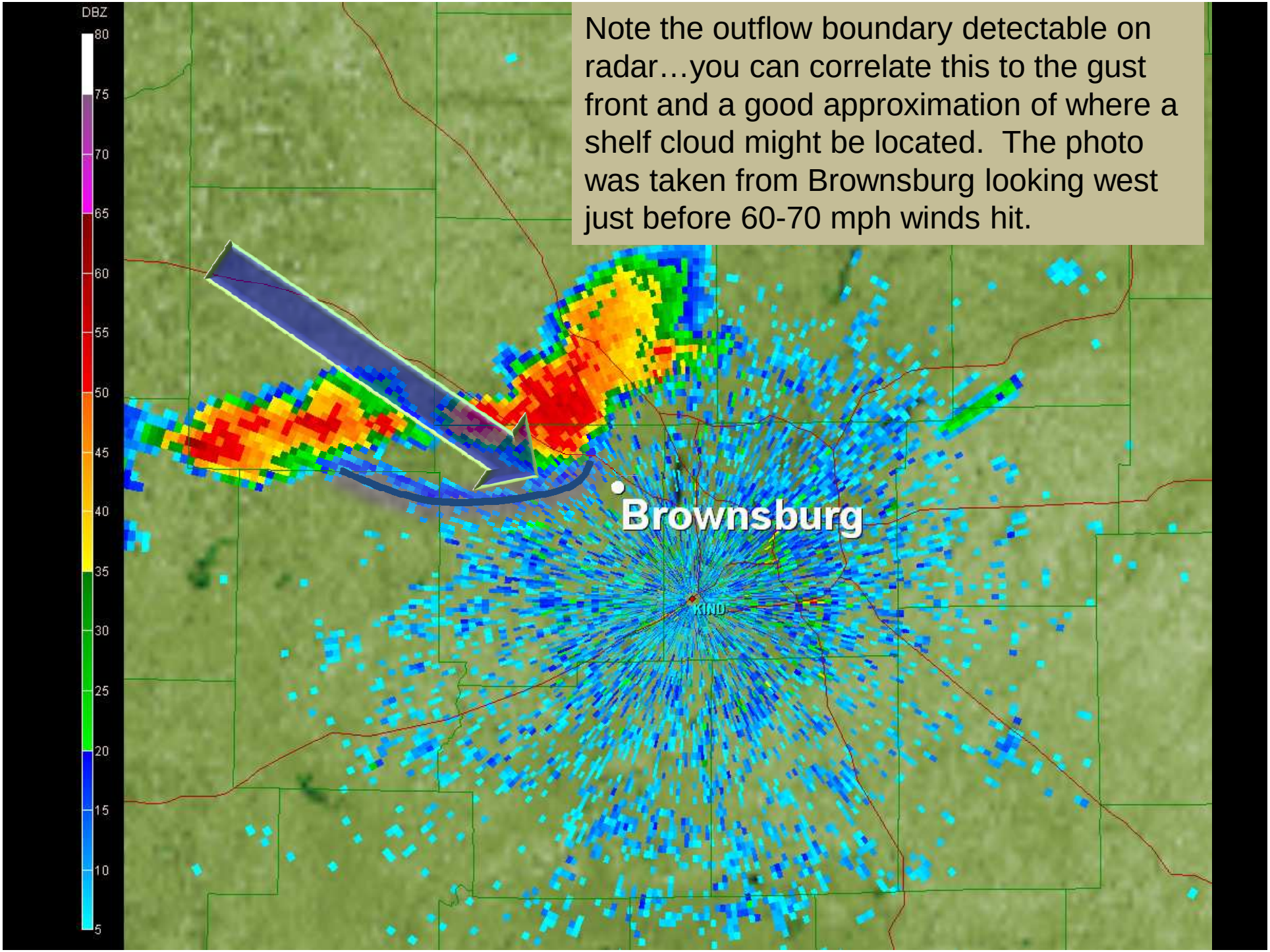
An outflow boundary, also known as a gust front, is the leading edge of gusty, cooler surface winds from thunderstorm downdrafts; sometimes associated with a shelf cloud or roll cloud.

You don't normally see an outflow boundary but you do feel it as winds pick up and temperatures drop and then rain/hail arrives and the shelf cloud passes overhead.



-SHELF CLOUD-

downburst winds


Note the outflow boundary detectable on radar…you can correlate this to the gust front and a good approximation of where a shelf cloud might be located. The photo was taken from Brownsburg looking west just before 60-70 mph winds hit.
DBZ
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
Brownsburg
KIND

DOWNDRAFTS

THUNDERSTORM DOWNDRAFTS ARE PRODUCED BY A COMBINATION OF:

1) FRICTIONAL DRAG

DOWNWARD-DIRECTED MOMENTUM DUE TO FALLING RAINDROPS

2) ENTRAINMENT

INGESTION OF DRIER AIR INTO THE PRECIPITATION CORE THAT EVAPORATES SOME OF THE FALLING RAIN PRODUCING NEGATIVE BUOYANCY

FRICTIONAL DRAG

FALLING RAIN DROPS PRODUCE DOWNWARD MOMENTUM AS AIR IS PULLED FROM BEHIND THE RAINDROP TOWARD THE GROUND

THE AMOUNT OF AIR PULLED DOWN (HELPS DETERMINE THE STRENGTH OF THAT PORTION OF THE DOWNDRAFT PRODUCED BY FRICTIONAL DRAG) IS A FUNCTION OF RAINDROP MASS (SIZE, & NUMBER OF RAINDROPS PER UNIT VOLUME) & DISTANCE (IN THE VERTICAL) THAT THE RAINDROPS FALL

IN GENERAL, THE HEAVIER THE RAINFALL, THE GREATER THE DOWNWARD MOMENTUM, & THE STRONGER THE RESULTING DOWNDRAFT

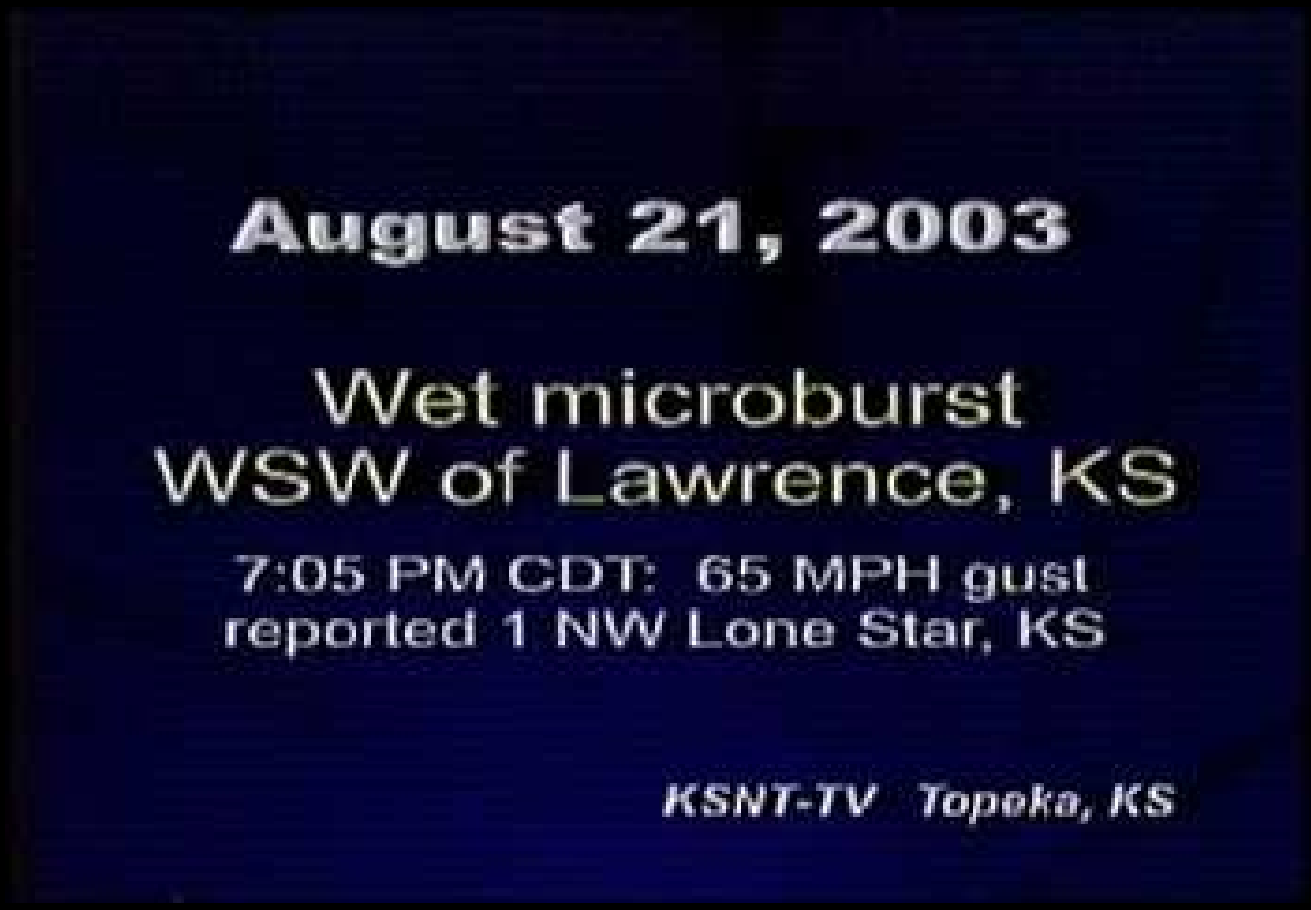
ENTRAINMENT

DRY AIR IN THE MID LEVELS OF THE STORM IS FED INTO THE PRECIPITATION CORE, EVAPORTING SOME OF THE RAIN & CREATING LARGE AMOUNTS OF NEGATIVE BUOYANCY

THE DRIER THE AIR THE GREATER THE EVAPORATION, & THE GREATER THE EVAPORATION, THE GREATER THE PRODUCTION OF NEGATIVE BUOYANCY AND THE GREATER THE POTENTIAL FOR DAMAGING WIND GUSTS.

THE LARGER THE NEGATIVE BUOYANCY, THE STRONGER THE DOWNDRAFT.

Microburst


August 21, 2003
Wet microburst
WSW of Lawrence, KS
7:05 PM CDT: 65 MPH gust
reported 1 NW Lone Star, KS
KSNT-TV Topeka, KS

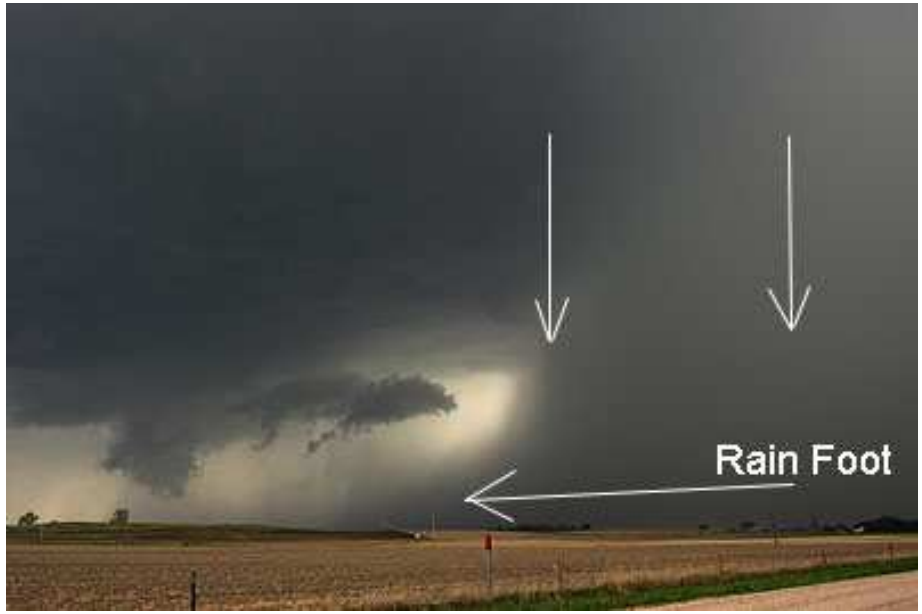
DOWNDRAFT AREA

Downbursts: Strong downdrafts from thunderstorms

- Rapid downward motions
- A “flare” appearance near the ground, or “rain foot”

Types of Downbursts:

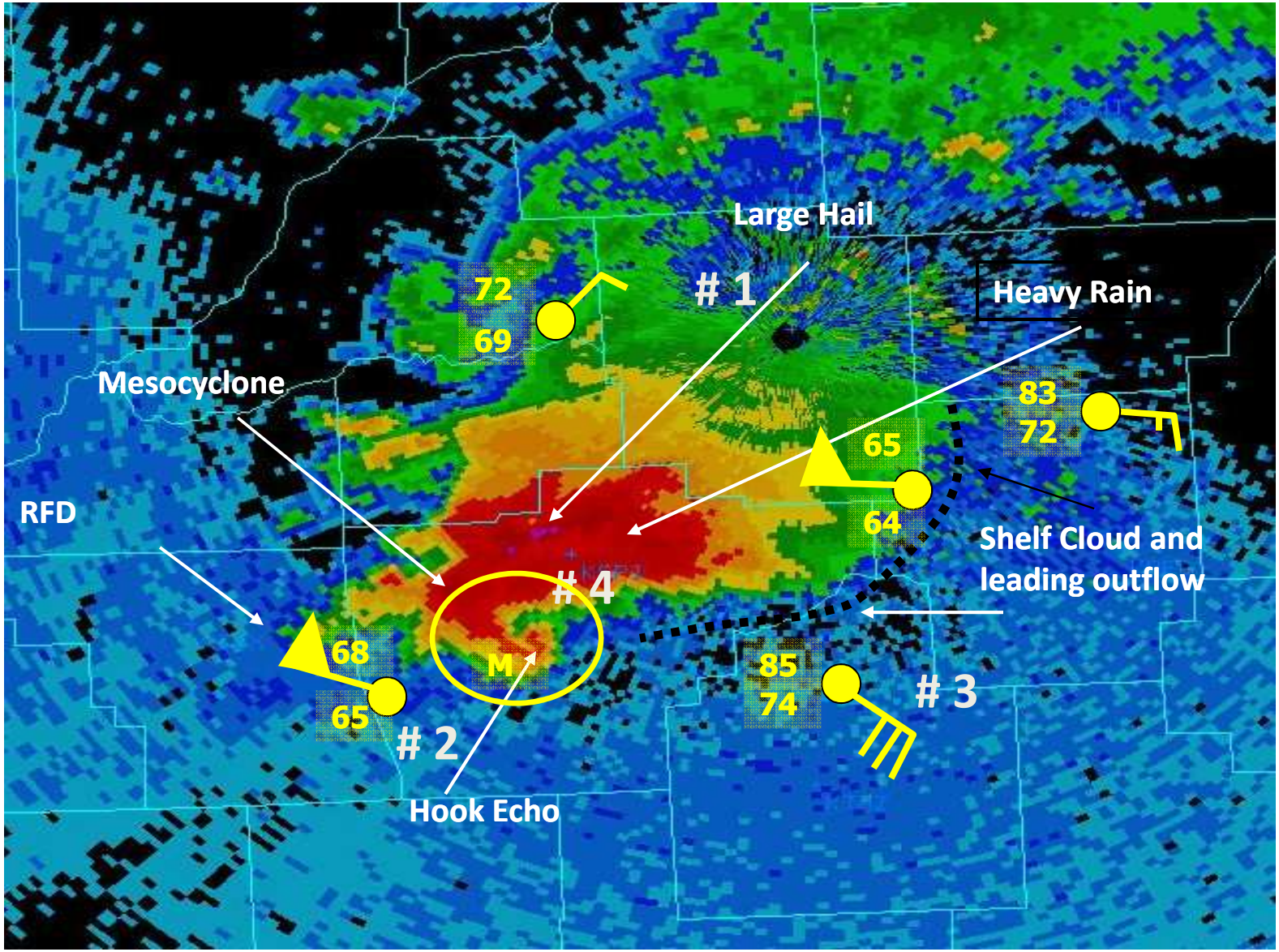
- Microbursts
- Macrobursts




You Be The Spotter!

Classic Supercell

A thunderstorm with a persistent and rotating updraft



Classic Supercell

A thunderstorm with a persistent and rotating updraft

This is what an observer might see from position 2, southwest of the hook region.

Classic Supercell

A thunderstorm with a persistent and rotating updraft

This is what an observer might see from position 1.

Classic Supercell

A thunderstorm with a persistent and rotating updraft

From position 3, observers may be looking north or northwest with an unobstructed view of a tornado. This is a good location relative to the storm to see a tornado. However, supercell thunderstorms can often begin to move to the right of the mean wind when they develop a strong mesocyclone (deviant movers). In this case, position 3 could become dangerous as the storm begins to turn southeast.

Classic Supercell

A thunderstorm with a persistent and rotating updraft

This position (#4) is the most dangerous and is affectionately referred to as “The Bear’s Cage”. This is in the direct path of the tornado and should be avoided at all costs.

What is this cloud feature? As this cloud approaches your location, what do you expect?

A. Wind at my back because I am looking at a wall cloud.

B. Wind at my back because I am looking at a microburst.

C. Wind at my face because I am looking at a shelf cloud.

D. Wind at my face because I am running away from it.

Is this a tornado?

In situations where you have low light and poor contrast, some spotters might hastily judge this harmless low cloud to be a funnel or tornado.

What is this?

Not making contact with the ground

No rotation

What is this feature?

ROTATING WALL CLOUD

What are these pictures of?

Rain Shafts

Is this a tornado?

Small debris cloud

Smooth condensation funnel

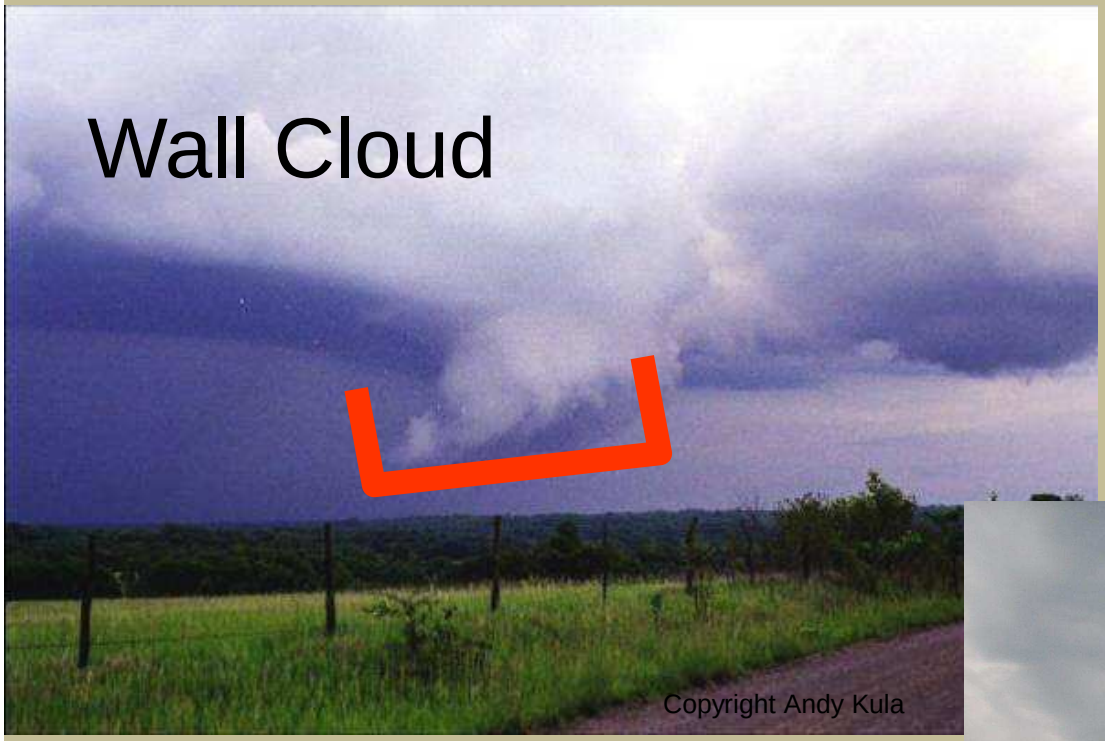
Rotating

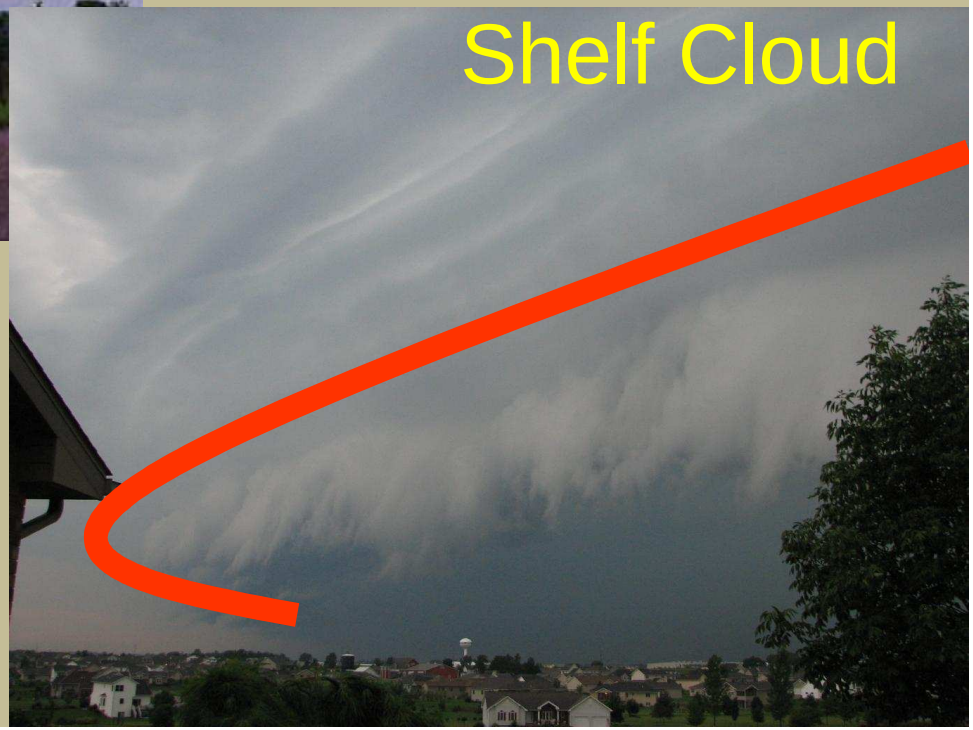
What is this?

It’s Rotating

Not making contact with the ground

Shelf cloud or wall cloud?



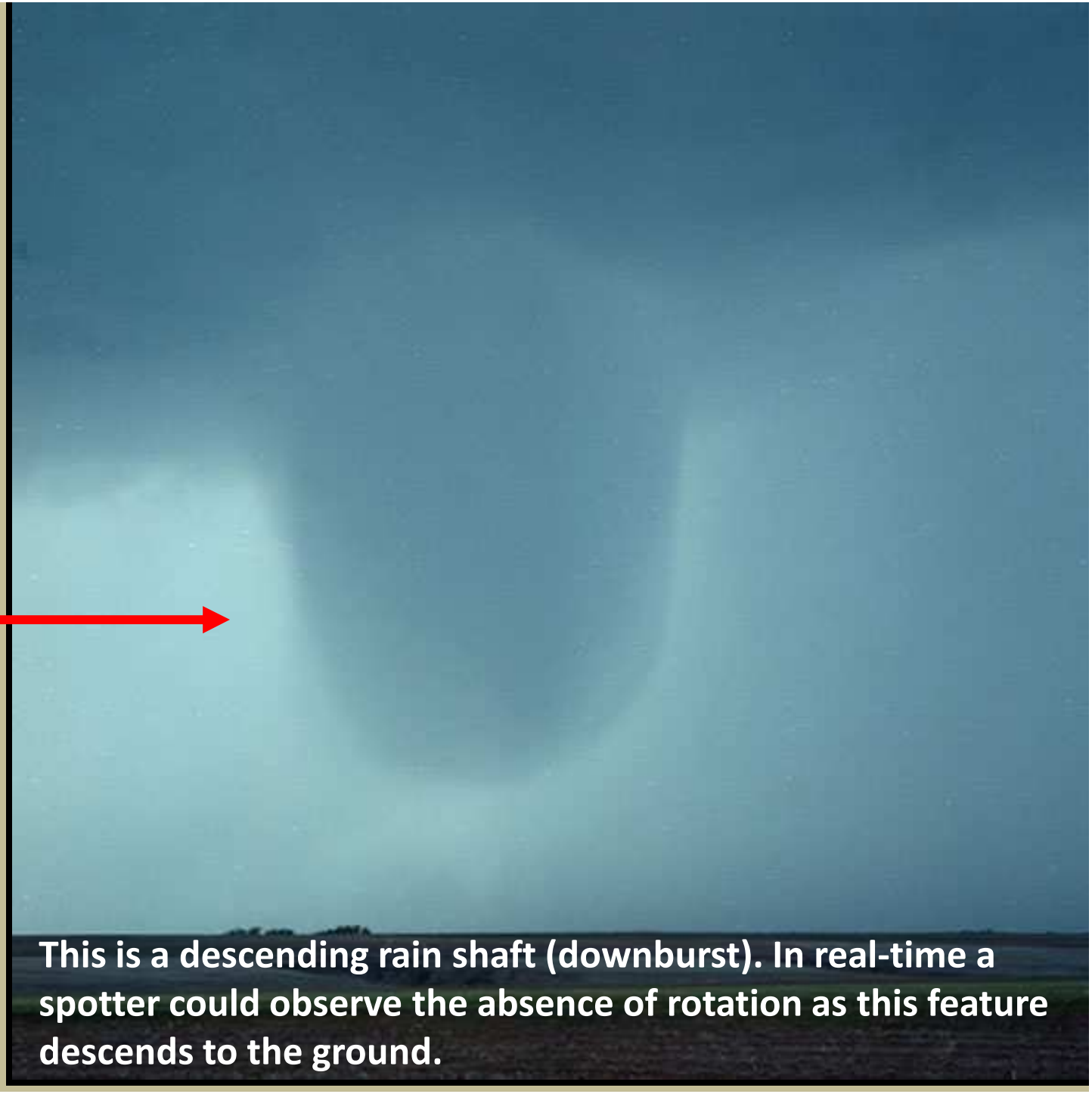


Does anything worry you in this image?


SHELF CLOUD

What is this feature?

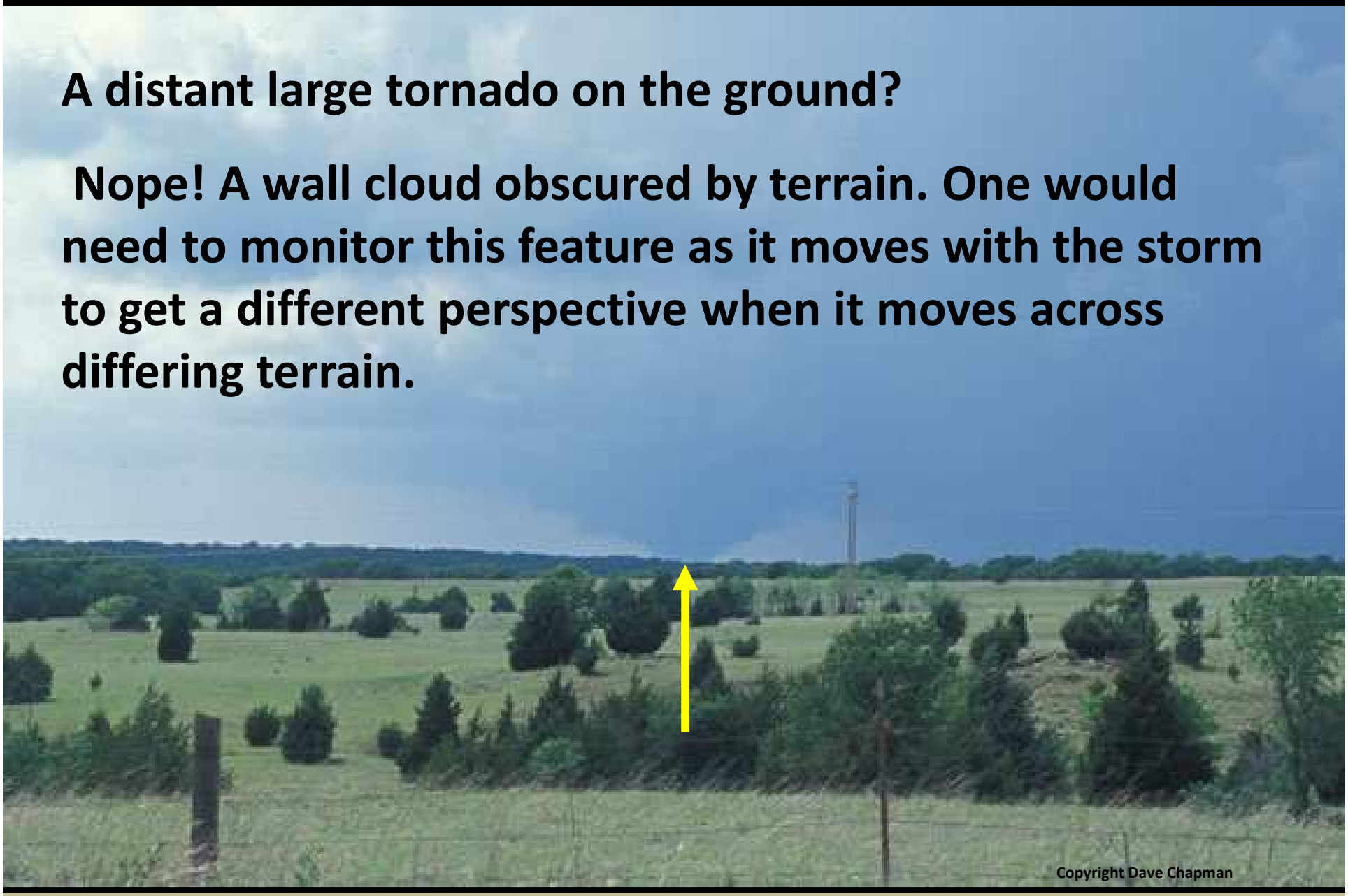
What about this feature?



This is a descending rain shaft (downburst). In real-time a spotter could observe the absence of rotation as this feature descends to the ground.

A distant large tornado on the ground?

Nope! A wall cloud obscured by terrain. One would need to monitor this feature as it moves with the storm to get a different perspective when it moves across differing terrain.



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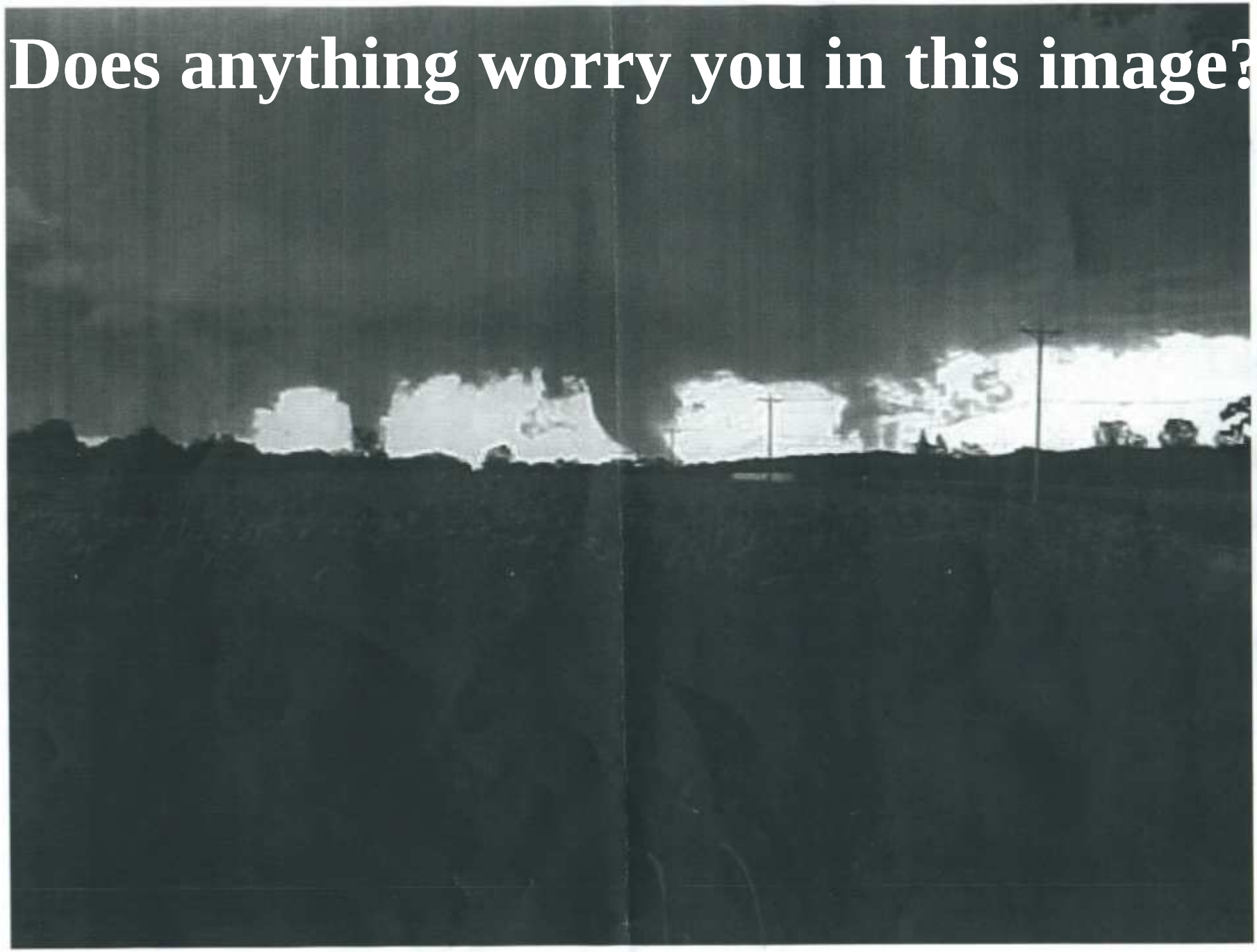


You are looking northeast
Clouds are moving northeast
Rain is just beginning